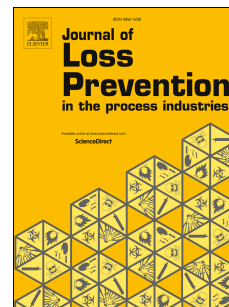


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Case Study of a Natural Gas Explosion in Beijing, China

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Abstract

Pipelines have nowadays become a major transport mode in our society. At about 13:23 on April 10, 2016, a natural gas explosion accident happened in Honglian south community of Haidian District in Beijing, China. One person was killed and 2 were injured in this accident. Because of the rupture of the pipeline during the excavation work, the natural gas leaked and explosive gas cloud was formed, leading to the gas explosion. The leaking parameters were calculated through basic theory. Based on the parameters, CFD software was used to rebuild the accident scene after the onsite investigation. The possibility of the formation of the explosive cloud was firstly confirmed through the leakage calculation. The results showed that the gas concentration in front of the building was flammable and the gas concentrated in the first floor were possible to form the explosive cloud. The explosion simulation was then performed. The results indicated that the natural gas of 9.5 % (v/v) filled in about one third of the room was enough to bring about such damage. So protecting the gas transport pipeline from external interference is very important to prevent such explosion accident. Some lessons and recommendations were also concluded from this typical accident.

Key words: natural gas; accident analysis; leakage; explosion; CFD simulation;

1 Introduction

The use of pipelines to transport large quantities of fuels to industry and civil consumers represents a reliable mode of transport of energy such as petroleum and natural gas. Natural gas has now become an important energy for daily life in a city. Taking Beijing (Municipal Administration Committee of Beijing, 2011.) for example, the amount of natural gas usage increased from 1.48 to 7.21 billion m³ per year during 2001 to 2010 (Fig. 1). The nation's pipeline networks are wide spread and vulnerable not only to the terrorist attack but also to the accidents (Parfomak, 2013). European Gas pipeline Incident data Group (EGIG) (2015) has collected 1309 pipeline incidents from 1970-2013 in Europe. And the overall incidents frequency is 0.33 incidents per year per 1,000 km during this period. Over 2003-2013, external interference, corrosion, construction defects and ground movement, represent 35%, 24%, 16% and 13% respectively of the pipeline incidents reported. External interference seems to be a major concern for the pipeline accident (Fig. 2.).

The external interference (i.e. digging, pilling) is usually made by the equipment such as anchor, bulldozer, excavator, plough and so on (Hongqing & Junfeng, 2005). The external interference increases the failure frequency of the transport equipment (CPR, 1999). The pipeline broken in this accident is directly due to the excavator. This natural gas explosion in the uptown is a quite typical one.

It happened in Honglian south community of Haidian District at about 13:23 on April 10, 2016. One person was killed and two were injured in this accident. The householder privately expanded the external balcony. So the pipeline maintenance staff misread the construction drawings. Also the

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